TOTAL MAXIMUM DAILY LOAD (TMDL) DEVELOPMENT

For Sediment in the

Stekoa Creek Watershed

303(d) Listed Stream Segments

Stekoa Creek

Scott Creek

Pool Creek

Chechero Creek

Saddle Gap Creek

August 30, 2000

United States Environmental Protection Agency

SUMMARY PAGE

for *Sediment* in Stekoa Creek Watershed, GA

The five streams in the Stekoa Creek Watershed were included on the State of Georgia's 1998 303(d) List because of biological and habitat impairment. Sediment was determined to be the pollutant of concern. Due to the restrictive timeframe imposed by the February 2000 Order on Consent in the Georgia TMDL lawsuit to propose and finalize certain TMDLs, this watershed TMDL was developed that provides estimates of the watershed's sediment delivery. The Stekoa Creek Watershed TMDL sediment delivery is expressed as an annual load of sediment from the watershed that potentially can reach the stream.

The specific 303(d) listed tributaries in the Stekoa Creek Watershed are:

Stream	Use Support Status	Pollutant of Concern
• Stekoa Creek	Partial Support	Excessive Sedimentation
• Scott Creek	Partial Support	Excessive Sedimentation
• Pool Creek	Partial Support	Excessive Sedimentation
• Chechero Creek	Not Supporting	Excessive Sedimentation
• Saddle Gap Creek	Partial Support	Excessive Sedimentation

The Stekoa Creek and tributary sedimentation problem can be divided into two issues: 1) sediment loading coming from the watershed and 2) instream sedimentation processes such as bank erosion and stream bottom down cutting. This Stekoa Creek Watershed TMDL only develops long – term annual sediment loads for the watershed. If the watershed sediment loads are reduced to an acceptable level, the stream will revert to its natural condition over time and the instream sedimentation processes will no longer be problematic. If actions are needed to restore these waters more quickly then instream restoration can be implemented.

The TMDL is expressed as an annual long - term loading value. For a biologically unimpacted healthy stream the annual long - term loading watershed sediment load is 8 tons per year per square mile. The Stekoa Creek Watershed TMDL determined the sediment watershed loading percent reductions that are needed to meet the unimpacted area loading rate are as follows:

Stream	**Area (Sq.Mile)**	**Existing Watershed Load (Tons/Year)**	**Percent Reduction Needed to Meet Target**
Stekoa Creek	17	470	55
Scott Creek	6	83	35
Pool Creek	5	45	10
Chechero Creek	4.4	82	55
Saddle Gap Creek	3	82	70

It is recommended that the Stekoa Creek watershed be considered a high priority for riparian buffer zone restoration and any sediment reduction BMPs, especially for the road crossings, agriculture activities, and construction activities. Further ongoing monitoring needs to be completed to monitor progress and to assure further degradation does not occur.

The February 2000 Order on Consent in the Georgia TMDL lawsuit requires EPA to propose TMDLs to address sediment for waters identified as impaired in the Chattooga Basin Report by December 31, 2000 and finalize these TMDLs within 120 days. The Chattooga Basin TMDL will also address the needed scope of an ongoing sediment monitoring plan for the Chattooga Watershed.

Waters on the State's 303(d) list that are located in the Savannah/Ogeechee Basins will be due for TMDL development again in 2004. According to the 1997 Consent Decree in the Georgia TMDL Lawsuit, TMDLs taking into consideration both point and nonpoint sources must be proposed by the State of Georgia on or before June 30, 2004 or by EPA on or before August 30, 2004. The TMDLs proposed in this document can then be revisited during that timeframe.

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Introduction

Section 303(d) of the Clean Water Act (CWA) as Amended by the Water Quality Act of 1987, Public Law 100-4, and the EPA's Water Quality Planning and Management Regulations [Title 40 of the Code of Federal Regulation (40 CFR), Part 130] require each State to identify those waters within its boundaries not meeting water quality standards applicable to the waters' designated uses. The identified waters are prioritized based on the severity of pollution with respect to designated use classifications. TMDLs for all pollutants violating or causing violation of applicable water quality standards are established for each identified water. Such loads are established at levels necessary to implement the applicable water quality standards with seasonal variations and margins of safety. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a water body, based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water-quality based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources. (EPA, 1991)

Location

The Stekoa Creek Watershed lies within the Tugaloo watershed located in northeastern Georgia (Figure 1). It flows into the Chattooga River and the Tugaloo Rivers at their confluence. Stekoa Creek drains an area of 40.7 square miles (26,066 acres) occupying the central portion of Rabun County, which borders Macon County, North Carolina, to the north. Through the Tugaloo River to the south, Stekoa Creek eventually flows into the Chauga River and Hartwell Reservoir.

Biological, habitat and storm-event sampling has been conducted at the following locations:

- SC-01 2.7 Stekoa Creek - 100 yards downstream US 23/441 Bridge
- SC-02 32.7 Stekoa Creek - Near Boggs Mountain Road
- SC-03 2.4 Cutting Bone Creek @ Mile 1.0

- SC-04 3.9 Scott Creek @ Mile 0.7
- SC-05 1.1 Pool Creek @ Mile 0.5; County Road 131
- SC-06 3.1 Chechero Creek @ New Hope Church
- SC-07 2.7 Saddle Gap Creek @ Duggan Hill Road

Problem Definition

The causes of impairment for waters in the Stekoa Creek Watershed on the State's 303(d) list were biological and habitat impairment. (EPA 1999a, Appendix A) Field studies confirmed the pollutant of concern to be sediment causing habitat impairment in the stream due to excessive sedimentation.

The specific 303(d) listed tributaries in the Stekoa Creek Watershed are:

Stream	Use Support Status	Pollutant of Concern
Stekoa Creek	Partial Support	Excessive Sedimentation
Scott Creek	Partial Support	Excessive Sedimentation
Pool Creek	Partial Support	Excessive Sedimentation
Chechero Creek	Not Supporting	Excessive Sedimentation
Saddle Gap Creek	Partial Support	Excessive Sedimentation

Previous reports, such as the "Sedimentation in the Chattooga River Watershed" report concluded that the Stekoa Creek watershed was the watershed in the Chattooga Basin most impacted by sedimentation, with the major source of the sediment being unpaved multipurpose roads. These roads were associated with about 80% of the sediment sources observed. The remaining sources were identified as timber harvest, agriculture, residential development, and recreation activities. Other contributors to the instream sediment load are heavy trafficking and increased maintenance of the unpaved roads, roads adjacent to the stream, pastures with unfenced riparian zones, ongoing development, "large quantities of fine sediment, both of natural and anthropogenic origin, which are gradually being flushed downstream, primarily during major storm events" and historic and current land use practices. (Vanlear 1995).

The Stekoa Creek and tributary sedimentation problem can be divided into two issues: 1) sediment loading coming from the watershed and 2) instream sedimentation processes such as bank erosion and stream bottom down cutting. This Stekoa Creek Watershed TMDL develops long – term annual sediment loads for the watershed. If the watershed sediment loads are reduced to an acceptable level, the stream will revert to its natural condition over time and the instream sedimentation processes will no longer be problematic. If actions are needed to restore these waters more quickly then instream restoration can be implemented.

Target Identification and Model Development

Model Development

For each watershed, the "existing" long – term sediment loading is estimated using the Universal Soil Loss Equation (USLE). The USLE is designed as a method to predict average annual soil loss caused by sheet and rill erosion. While it can estimate long - term annual soil loss and guide proper cropping, management, and conservation practices, it cannot be applied to a specific year or a specific storm.

The sediment TMDL watershed load is calculated using the rainfall erosivity index (R), a statistic calculated from the annual summation of rainfall energy in every storm (correlated with raindrop size) times its maximum 30 - minute intensity. The watershed sediment load TMDL development incorporates consistent default parameters and inputs for each watershed. These default parameters include the Multi-Resolution Land Cover (MRLC) land use data, the 30 meter USGS Digital Elevation Model (DEM) data, the STATSGO soil information and Georgia Department of Transportation Road information. The total amount of sediment delivery for each watershed of interest is calculated. The sediment delivery is calculated for the composite or total watershed sediment delivered to the streams and is broken down into the amount of sediment coming from roads and the amount of sediment coming from the various land uses or land covers. Details of the modeling work are included in the Draft EPA Region 4 Modeling Report – Stekoa Creek Watershed Sediment Modeling. (EPA 2000)

Narrative Standard

The narrative standard is to maintain biological integrity of the waters of the State – Georgia's Water Quality Standard is established in Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6, Revised November 23, 1998. Georgia Regulation 391-3-6-.03(2)(a).

Numeric Target

The working hypothesis for the sediment watershed load is that if the Stekoa Creek Watershed has a long – term annual sediment load similar to a biologically unimpacted healthy stream, then the Stekoa Creek Watershed will remain stable and not be biologically impaired due to sediment. Conversely, if the Stekoa Creek Watershed sediment concentrations exceed the unimpacted stream's long – term annual sediment load then the stream will be unstable and biologically impaired.

Unimpacted streams in the West Fork Watershed of the Chattooga River Basin were used to develop a target sediment watershed load. The unimpacted stream's watershed sediment loading rate per area was 8 tons/year/square mile. The same watershed sediment modeling procedures were used to determine the unimpacted watershed loading rate. A percent reduction TMDL can be developed by comparing the impacted watersheds sediment loading rate to the unimpacted watersheds sediment loading rate.

Sediment Sources

Point Source:

One point source is located in the Stekoa Creek Watershed, Clayton Wastewater Treatment Facility (Permit # GA0021806) discharges directly to Stekoa Creek below Clayton. With an assumed design discharge flow of 0.5 million gallons per day; the total sediment load is 57 kg/day of Total Suspended Solids (TSS) or 0.5% of the watershed's allowable low flow year load. This point source sediment load does not represent a significant impact on the stream's sediment budget. (EPA 2000a) Since the point source load is a minor component and the organic "sediment" being measured by the TSS monitoring does not necessarily cause a habitat problem, this TMDL will only address the major sedimentation problems coming from the watershed and not address further the minor point source contributions.

Existing Watershed Sediment Loads:

The current estimated long – term area weighted watershed sediment loads for the Stekoa Creek Watershed 303(d) listed tributaries are listed in Table 1. The long – term sediment watershed load was broken down by land use sediment sources and road erosion sediment sources. The individual tributary watersheds are illustrated in Figure 2. A map of the landuse distribution and the road and stream network are illustrated in Figures 3 and 4.

The Stekoa Creek Watershed also consists of two 12 digit hydrologic unit code (HUC) watershed delineations, which contain the 303(d) listed streams. For each of these 12 digit HUCs a detailed sediment load by individual land coverage is provided in Table 2.

Table 1. Stekoa Creek Watershed Sediment Loads

Tributary Watershed	Area (Sq.Mi.)	Total Sediment Load (Tons/Year)	Total Sediment Area Weighted Load (Tons/Year/Sq.Mi.)	Landuse Sediment Load (Tons/Year)	Road Sediment Load (Tons/Year)
Scott Creek	6.27	82.7	12.4	69.0	13.7
Saddle Gap Creek	2.75	72.3	25.7	36.1	36.2
Chechero Creek	4.36	81.6	18.6	8.1	73.5
Pool Creek	5.0	45.3	9.1	2.4	42.9
Stekoa Creek Above Clayton	2.42	121.9	50.7	8.0	113.9
Stekoa Creek Below Clayton	17.1	469.6	17.3	77.5	392.1
Cutting Bone Creek	2.63	16.4	6.2	2.7	13.7
Stekoa Creek Watershed Outlet	40.4	700.	17.5	104.	596.

Total Maximum Daily Load (TMDL)

Seasonal Variation

Since a long - term annual average sediment load in mass per time units is estimated, seasonality is taken in to account through the R factor.

Margin of Safety

The Margin of Safety (MOS) is implicitly assigned by selection of average USLE factors. Note that either excess or a lack of sediment in the stream can be a detriment to stream health, therefore use of average values is a reasonable approach.

TMDL Determination

The TMDL is expressed as a percent reduction of an annual long - term watershed sediment loading value. For a biologically unimpacted healthy stream the annual long - term loading watershed load is 8 tons per year per square mile. The Stekoa Creek Watershed TMDL determined the watershed loading percent reductions. These reductions are presented in Table 2.

Allocation of Responsibility and Recommendations

The upper portion of the Stekoa Creek Watershed is the major sediment producing area, while the lower portion of the Stekoa Creek Watershed meets the TMDL target. The sediment coming from the upper watershed and historic instream processes impacts Lower Stekoa Creek.

Roads, agriculture and bare ground (construction sites, etc.) sediment sources are the major sediment producing areas in the upper watershed. If appropriate efficient best management practices (BMPs) for these practices and other sediment producing activities are implemented at the sites that are near the stream’s drainage network and the stream’s riparian zone or buffer zones are maintained or restored then the TMDL targets can be met.

Table 2. Stekoa Creek Watershed Loading Rate Reductions

Tributary Watershed	Total Sediment Load (Tons/Year)	Total Sediment Area Weighted Load (Tons/Year/Sq.Mi.)	Target Sediment Area Weighted Load (Tons/Year/Sq.Mi.)	Percent Reduction Needed
Scott Creek	82.7	12.4	8	35%
Saddle Gap Creek	72.3	25.7	8	70%
Chechero Creek	81.6	18.6	8	55%
Pool Creek	45.3	9.1	8	10%
Stekoa Creek Above Clayton	121.9	50.7	8	95%
Stekoa Creek Below Clayton	469.6	17.3	8	55%
Cutting Bone Creek	16.4	6.2	8	--
Stekoa Creek Watershed Outlet	700.	17.5	8	55%

Upper Stekoa Creek Watershed – HUC 0306002001

Land use	Area (acres)	Total Sediment Load (Tons/Year)
Open Water	5.34	0.00
Low Intensity Residential	77.84	38.92
High Intensity Residential	28.24	0.75
High Intensity Commercial	108.52	4.70
Quarries, Bare Soil & Construction	4.44	78.91
Deciduous Forest	6494.37	59.80
Evergreen Forest	1536.47	8.47
Mixed Forest	3610.90	19.58
Pasture/Hay	549.07	15.90
Row Crops & Construction	145.44	226.98
Other Grasses -Urban/recreational	222.39	13.94
Woody Wetlands	1.11	0.50
Emergent Herbaceous Wetlands	0.44	0.04

Roads	---	81.77

Lower Stekoa Creek Watershed – HUC 0306002002

Land use	Area (acres)	Total Sediment Load (Tons/Year)
Open Water	3.78	0.00
Low Intensity Residential	26.46	14.39
High Intensity Residential	0.67	0.00
High Intensity Commercial	4.45	0.23
Transitionnel	20.46	0.41
Quarries, Bare Soil & Construction	4.00	78.91
Deciduous Forest	3680.73	33.56
Evergreen Forest	1920.98	9.87
Mixed Forest	3367.61	19.93
Pasture/Hay	132.32	7.31
Row Crops & Construction	30.91	66.30
Other Grasses -Urban/recreational	58.71	3.13
Woody Wetlands	0.89	0.42
Emergent Herbaceous Wetlands	0.22	0.00

Roads	---	11.38

Schedule for the Next Phase of the TMDL

The February 2000 Order on Consent in the Georgia TMDL lawsuit requires EPA to propose TMDLs to address sediment for waters identified as impaired in the Chattooga Basin Report by December 31, 2000 and finalize these TMDLs within 120 days. The Chattooga Basin TMDL will also address the needed scope of an ongoing sediment monitoring plan for the Chattooga Watershed.

Waters on the State's 303(d) list that are located in the Savannah/Ogeechee Basins will be due for TMDL development again in 2004. According to the 1997 Consent Decree in the Georgia TMDL Lawsuit, TMDLs taking into consideration both point and nonpoint sources must be proposed by State of Georgia on or before June 30, 2004 or by EPA on or before August 30, 2004. The TMDL proposed in this document can then be revisited during these timeframes.

Recommendations

It is recommended that the Stekoa Creek watershed be considered a high priority for riparian buffer zone restoration and any sediment reduction BMPs, especially for the road crossings, agriculture activities, and construction activities. Further ongoing monitoring needs to be completed to monitor progress and to assure further degradation does not occur.

Upper Stekoa Creek Watershed – HUC 0306002001

Stekoa Creek Watershed

A 55 percent sediment load reduction for upper Stekoa Creek Watershed is needed to meet the estimated watershed sediment loading reduction target. The main contributors to the Stekoa Creek watershed sediment load are 1) construction and crops causing fifty percent of the loading and 2) roads causing fifteen percent of the loading. To meet the proposed target, specific BMPs should be implemented for crops, construction and roads that reduce each of their respective sediment contributions.

Scott Creek Watershed

A 35 percent sediment load reduction for Scott Creek Watershed is needed to meet the estimated watershed sediment loading reduction target. The main contributors to the Scott Creek watershed sediment load are 1) construction and crops causing fifty percent of the loading and 2) roads causing ten percent of the loading. To meet the proposed target, specific BMPs should be implemented for crops, construction and roads that reduce each of their respective sediment contributions.

Saddle Gap Creek Watershed

A 70 percent sediment load reduction for Saddle Gap Creek Watershed is needed to meet the estimated watershed sediment loading reduction target. The main contributors to the Saddle Gap Creek watershed sediment load are 1) construction and crops causing twenty five percent of the loading and 2) roads causing sixty percent of the loading. To meet the proposed target, specific BMPs should be implemented for crops, construction and roads that reduce each of their respective sediment contributions. Since roads are a major contributor, this should be a major BMP implementation area.

Lower Stekoa Creek Watershed – HUC 0306002002

Chechero Creek Watershed

A 55 percent sediment load reduction for Chechero Creek Watershed is needed to meet the estimated watershed sediment loading reduction target. The main contributors to the Chechero Creek watershed sediment load are 1) construction and crops causing fifty percent of the loading and 2) roads causing ten percent of the loading. To meet the proposed target, specific BMPs should be implemented for crops, construction and roads that reduce each of their respective sediment contributions.

Pool Creek Watershed

A 10 percent sediment load reduction for Pool Creek Watershed is needed to meet the estimated watershed sediment loading reduction target. The main contributors to the Pool Creek watershed sediment load are 1) construction and crops causing twenty five percent of the loading and 2) roads causing ten percent of the loading. To meet the proposed target, specific BMPs should be implemented for crops, construction and roads that reduce each of their respective sediment contributions.

Figure 1. Location of Stekoa Creek Watershed

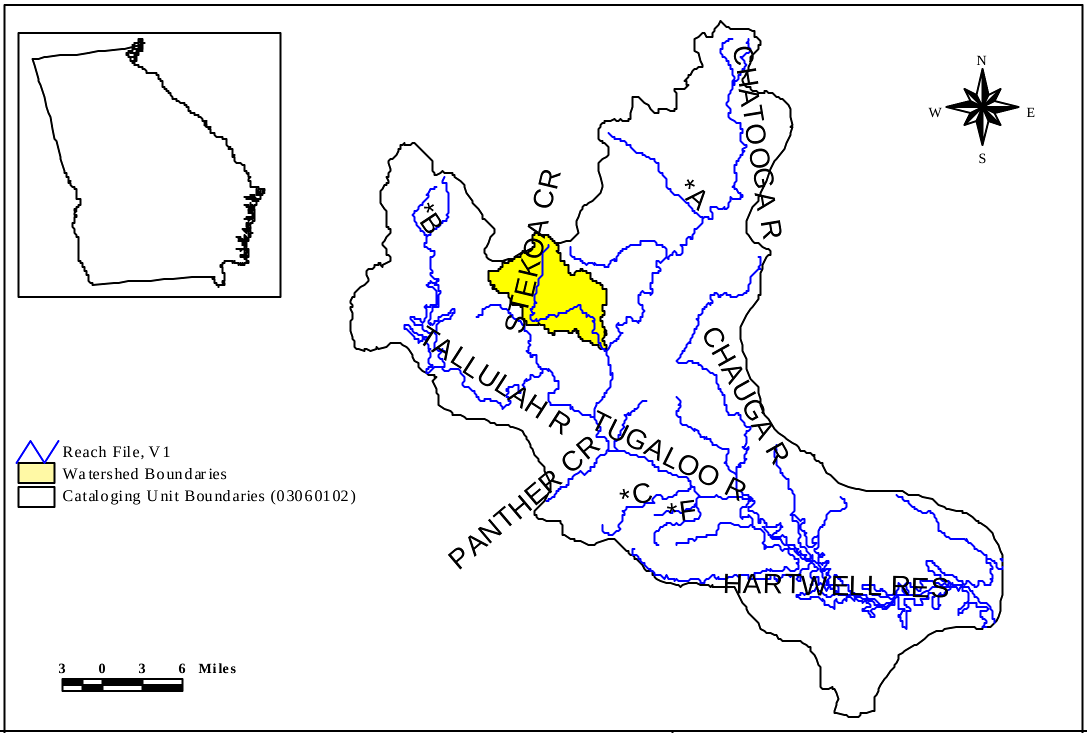


Figure 1-1. Site Location Map.
STEKOA CREEK

Map Projection: Albers Equal Area GRS 80
Data Sources Unknown Data Source

Figure 2 - Watershed Tributaries

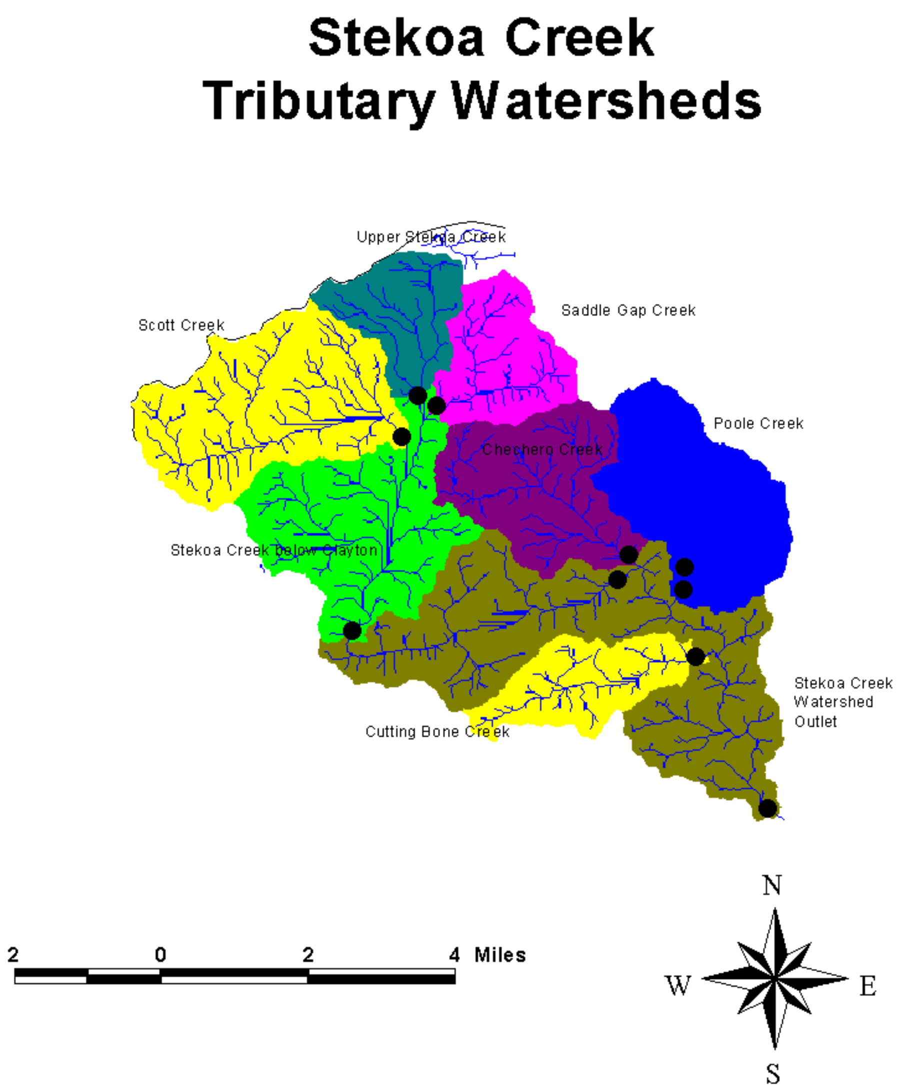


Figure 3 – Land Use Distribution

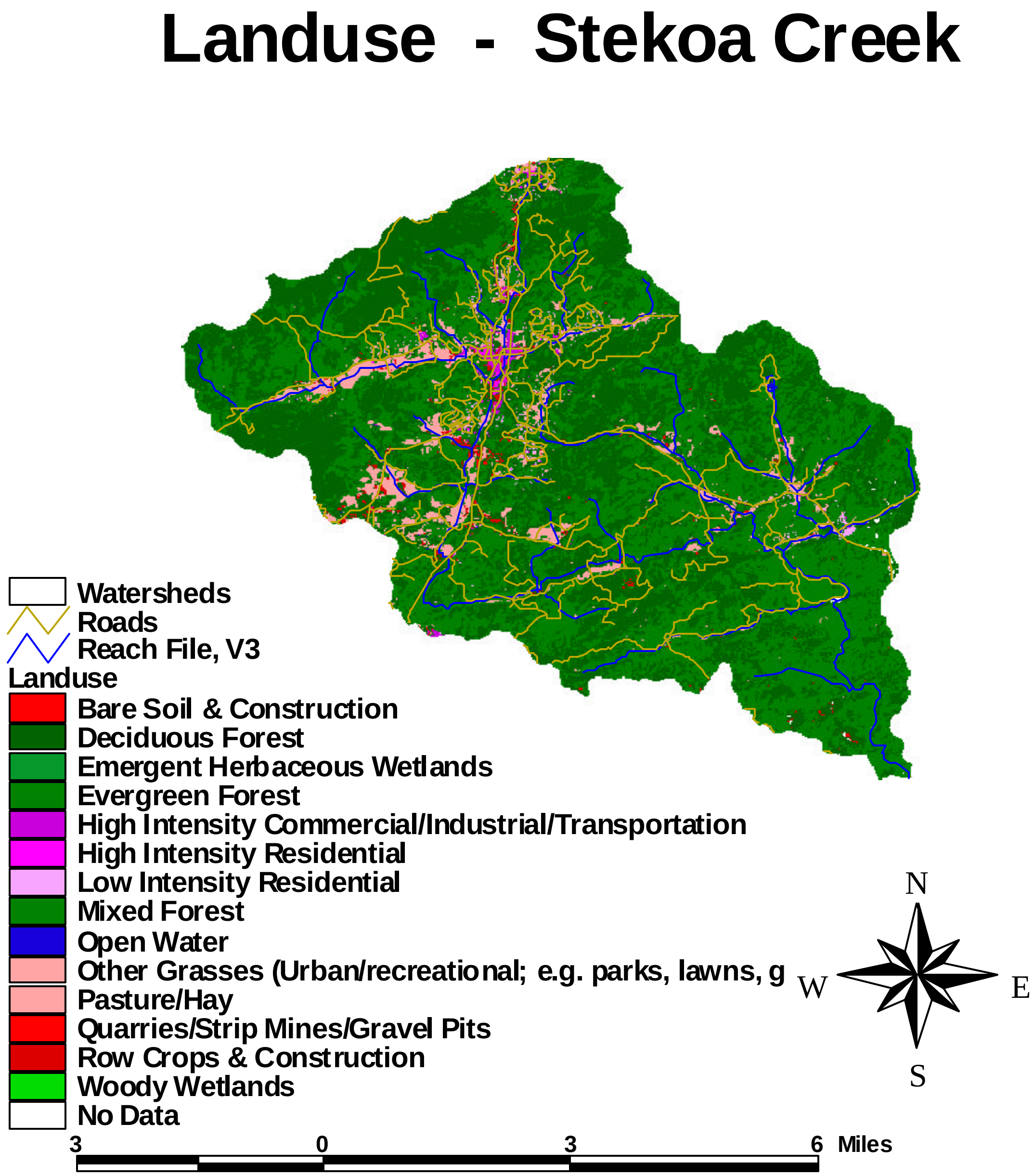
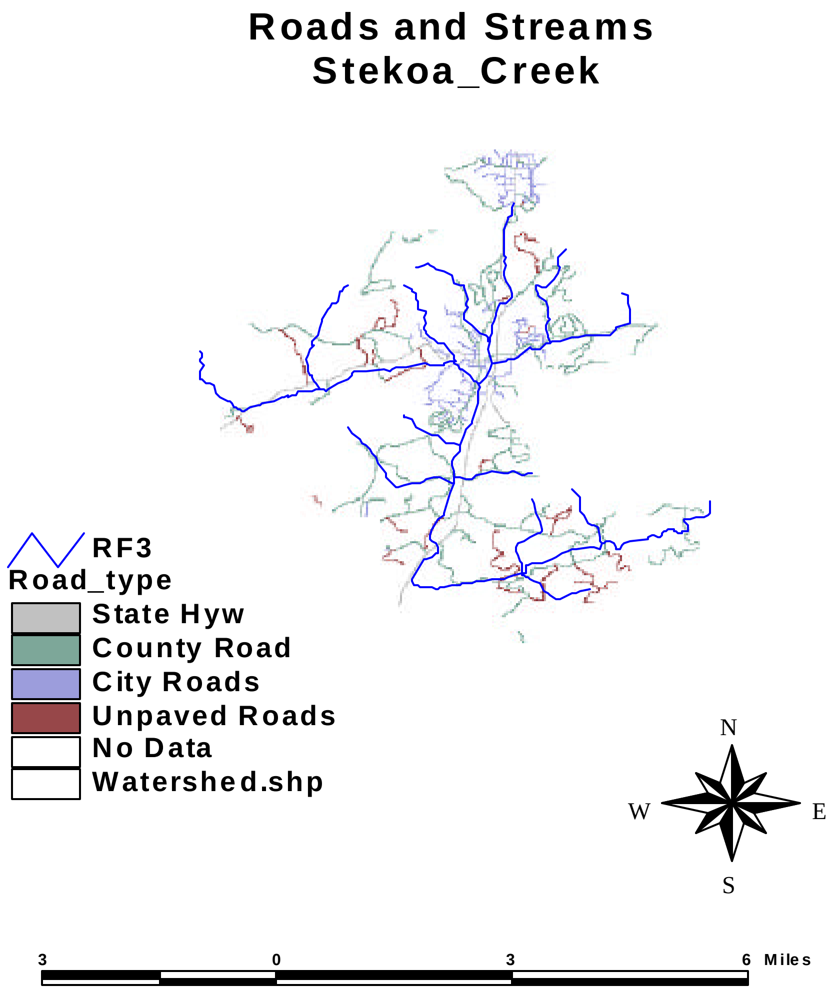


Figure 4 – Road and Stream Network



Appendix A: Biological and Habitat Data and Information

Stekoa Creek Watershed

Excerpts from "Assessment of Water Quality Conditions Chattooga River Watershed", USEPA Region 4. 1999.

Stekoa Creek

The results of the sediment measures are presented in Table 8. The results of the habitat analyses are presented in Table 9. The results of the use support analyses phase of the study are presented in Table 10. Tables 8, 9, and 10 are included in Appendix B. The results of the chemical and physical analyses are presented in Appendix F. Results of the rating of each of the study streams are discussed below.

The results of the analyses on Stekoa Creek at both SC01 and SC02 indicate that the designated uses of this stream are partially supported. The biological ranking was fair at both SC01 and SC02 indicating some impairment of the community. The biological community at both locations are impacted and community structure reflect the poor conditions of the stream. The results of the analyses indicate that the cause of the impairment is likely due to the increase in sediment which is primarily sands. The habitat rankings of both the RBP and Pfankuch indicated impacted habitat conditions at SC01. Some improvement in habitat was noted at SC02; however, the ranking was still in the fair range for the Pfankuch rating. The bottom substrate characteristics indicated that sand size and smaller particles were very prominent in this stream. Stekoa Creek is currently listed on Georgia EPDs 303(d)list with fecal coliform being the pollutant of concern. Due to the impacted condition of the aquatic macroinvertebrate community, this stream should also be listed as partially meeting designated uses due to impairment of the biological community with the likely pollutant of concern listed as sediment.

Five streams that are tributaries to Stekoa Creek were also sampled. Three of these streams showed adverse impacts to the biological community. Pool Creek and Saddle Gap Creek had fair ratings for the macroinvertebrate community and Chechero Creek rated poor at the sample station location. Scott Creek, Saddle Gap, and Chechero Creeks had fair RBP habitat ratings while Pool Creek had poor habitat conditions. Analysis of the sediments of the stream indicated that these streams also had substrates dominated by fine sediments and sand sized particles. The biological condition of Scott Creek was good; however, due to habitat degradation, primarily related to the large amount of sand in the substrate, the designated use support is threatened. Based on the results of the analyses Stekoa Creek and the tributaries of Chechero Creek, Saddle Gap Creek, and Pool Creek are not fully supporting designated uses. Therefore, these streams should also be included on Georgia EPD=s 303(d) list with sediment listed as the pollutant of concern. Cutting Bone Creek was also sampled and the biological community was rated as good and the habitat was rated as good. However, observations of field personnel and sediment measures indicated that the stream substrate showed areas of increasing sediment deposits . The stream is recommended to be listed as fully supporting designated uses but placed on a Awatch@ list to provide increased attention to controlling sources of sediment inflow to the stream.

Appendix B: EPA's "Protocol for Developing Sediment TMDLs"

Excerpts from EPA's "Protocol for Developing Sediment TMDLs", October 1999

The traditional approach to TMDL formulation is to identify the total capacity of a waterbody for loading of a specific pollutant while meeting water quality standards. This loading capacity is not to be exceeded by the sum of pollutant loads allocated to individual point sources, nonpoint sources, and natural background. Therefore, TMDLs have often been expressed in terms of maximum allowable mass load per unit of time. However, alternative approaches to sediment TMDL analysis might also be appropriate. In many cases, it is difficult or impossible to relate sediment mass loading levels to designated or existing use impacts or to source contributions. These analytical connections can be difficult to draw for several reasons, including the following: Sediment yields vary radically at different spatial and temporal scales, not only within a watershed, but across the country, making it difficult to derive meaningful "average" sediment conditions. Sediments are a natural part of all waterbody environments, and it can be difficult to determine whether too much or too little mass loading is expected to occur in the future and how sediment loads compare to natural or background conditions. A significant level of uncertainty is associated with sediment delivery, storage, and transport estimates. Fortunately, it is acceptable for TMDLs to be expressed through appropriate measures other than mass loads per time (40 CFR 130.2). It is important to note, however, that some of the limitations associated with mass load approaches, such as high temporal variability, are also present in the alternative approaches and the consequences of these limitations should be assessed and acknowledged. The alternative measures for sediment TMDLs can take several forms, including the following: Expression of numeric targets in terms of substrate or channel condition, aquatic biological indicators, or hillslope indicators such as road stream crossings with diversion potential or road culvert sizing. The hillslope indicators and targets should complement in-stream indicators and targets. Expression of numeric targets and source allocations in terms of time steps different from daily loadings and as functions of other watershed processes such as precipitation or runoff. Expression of allocations in terms other than loads or load reductions (e.g., specific actions shown to be adequate to result in attainment of TMDL numeric targets and water quality standards.

Some erosion occurs in all watersheds, even those which are completely undisturbed. Some watershed types are extremely prone to periodic major sedimentation events. Designated uses located in such settings have often adapted to naturally high sediment conditions. TMDLs need to distinguish sedimentation rates associated with human activities in the study watershed from those associated with naturally occurring (and presumably uncontrollable) sediment sources. Human land management activities can change the magnitude, locations, and timing of land erosion or runoff events as well as the key physical characteristics of receiving waters. Methods sensitive to changes in the driving forces that influence sedimentation (e.g., models like RUSLE, HSPF, and WRENSS) will be useful in comparing natural and anthropogenic sources if data about key processes are available for the TMDL study area and reference watersheds. Methods that estimate sediment loading or yields as a function of sediment concentration and streamflow (e.g., rating curves) are less useful in evaluating how existing sedimentation rates differ from natural sedimentation rates. Where rating curve methods are used, careful comparison to reference watersheds (and the underlying differences in land use or land characteristics) can assist in comparing natural and human-caused sedimentation. A sediment budget is an "accounting of the sources and disposition of sediment as it travels from its point of origin to its eventual exit from a drainage basin" (Reid and Dunne, 1996).

Sediment budget analyses are useful both for the conceptualization of sediment problems and as a tool for estimating sediment loadings. Full-scale sediment budgeting provides an inventory of the sources of sediment in a watershed and estimates sediment production and delivery rates from each source. Component processes are identified, and process rates are usually evaluated independently of one another. All of the relevant processes are quantified, including hillslope delivery processes (creep, mass movement), channel sources (e.g., bank collapse), in-channel storage, bedload and suspended sediment transport capacity, and net sediment yield from the basin. If the effects of particular land use activities on each process are known, the overall influence of a suite of existing or planned land use activities can be estimated.

One method for establishing target values is comparison to reference sites—waterbodies that are representative of the characteristics of the region and subject to minimal human disturbance. Where narrative standards are involved, assessing environmental conditions in receiving waters often depends on comparing observed conditions to expected conditions. This comparison is typically done by comparing data collected from impaired sites to similar data from the same sites collected before impairment and/or from one or more appropriate reference sites where designated uses are in good condition. Conditions at the reference site (e.g., suspended sediment concentrations) can then be interpreted as approximate targets for the indicators at the impaired site. A disadvantage to this approach is that it might not aid in determining an impairment threshold. Reference sites may represent the completely unaffected state, a relatively unaffected state, or increasing degrees of existing impact.

Appendix C: Reference and Administrative Record Index

Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03, Water Use Classifications and Water Quality Standards, November 1998

Sierra Club v. EPA & Hankinson USDC-ND-GA Atlanta Div. #1: 94-CV-2501-MHS, 1998

USEPA. 1991. Guidance for Water Quality-based Decisions: The TMDL Process. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA/440/4-91-001, April 1991.

USEPA Region 4. 1999a. “Assessment of Water Quality Conditions Chattooga River Watershed”

USEPA. 1999b. “Protocol for Developing Sediment TMDLs, First Edition”

USEPA Region 4. 2000. Draft EPA Region 4 Modeling Report – Stekoa Creek Watershed Sediment Modeling. August 2000.

USEPA Region 4. 2000a. Total Maximum Daily Load (TMDL) Development for Sediment in the Stekoa Creek Watershed. May 2000

USEPA Region 4. 1999. Chattooga River Watershed Hydrologic / Sedimentation Study. Bruce A. Pruitt, U.S. Environmental Protection Agency, Region 4 Science and Ecosystem Support Division. April 1999

Vanlear 1995. “Sedimentation in the Chattooga River Watershed” Technical Paper No. 19. Clemson University. Vanlear, Taylor and Hansen.